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VOL. 2.] THIRD QUARTER, 1929. [No. 3.

EDITORIAL.

IN this, the first issue of the *Journal* to be issued under my Editorship, it is perhaps meet and proper that I should tender a note of greeting to readers, and indeed to all those interested directly or indirectly in agricultural pursuits in the Colony of Fiji. To most of you I am still a stranger enveloped in a more or less mysterious veil, to some a signature of doubtful caligraphic excellence, and to a few, a person whom they have met and of whom they expect much. I am grateful for the welcome extended to me by the several organisations and individuals whom I have met and hope that I shall be able to work in harmony with them and with all those who have the agricultural interests of the Colony sincerely at heart.

The possibilities and prospects of agriculture in its varied forms in Fiji impress me, and indicate to me the fields of inquiry and extensions as yet barely touched upon. The wonderful results achieved by my predecessor, Dr. Tothill, must for all time be recognised as of immense value to Fiji and the occasion of justifiable pride on his part and on the part of all those associated with him. I have been told that in succeeding Dr. Tothill I have a difficult position to fill, but I am not appalled by the prospect. The necessary concentration of departmental activities upon a menace to the copra industry, the importance of which could not be over-estimated, meant that other agricultural activities had to be placed in a subordinate position, and deferred to a large extent until such time as the major problem had been successfully solved. That time is now with us and those less important matters, now of major import, are before us. It is our duty to face them.

This is not the proper place to define or discuss agricultural policy, but I may perhaps be permitted to sound a note of caution, and to indicate the prime necessity of testing thoroughly under local conditions all matters connected with agricultural development, such as the introduction of new crops, or of new varieties of crops now grown in the Colony; of improved methods of cultural practice; of manurial schemes, and of market prospects, before making recommendations for general adoption. Indiscriminate importation of seeds and plants for trial under any other but expert observation and control is most undesirable and may be dangerous to the welfare of an agricultural community. Many examples illustrative of this truth could be given and those that are with us in Fiji should be more than sufficient. Agricultural development cannot be hurried, nor can it be satisfactorily effected without the sympathy and co-operation of the agricultural community, irrespective of nation or colour. Agriculture is an art and a business and must be so regarded if success is to attend endeavours to improve and develop it. It is a business which cannot satisfactorily progress without

properly directed investigation, and practical assistance by trained scientific observers. This has now been recognised for some time, and the death knell of the old " hit or miss " method has been sounded.

We in Fiji have many lines of agricultural inquiry before us which will receive attention, but early results must not be expected. There exist organisations in many parts of the Empire established to investigate the multifarious aspects of agriculture, and we have the benefit of their trials, errors and successes to assist us in our endeavours. Our success as agriculturalists must, however, mainly depend on our own efforts, actuated and directed by a common bond of sympathy and co-operation, having for its object individual and communal prosperity for these delightful islands in which our sphere of life and work lies.

In conclusion, I would voice what I feel is the general wish for the happiness and success of Dr. Tothill in his new field of activity in Uganda.

STAFF NOTES.

Mr. A. C. Barnes, F.I.C., B.Sc., A.M.I.Ch.E., arrived in the Colony on 9th August, 1929, and assumed duty as Superintendent of Agriculture.

Mr. H. W. Simmonds, F.E.S., sailed by the R.M.M.S. "Aorangi" for Auckland on 5th September *en route* for Trinidad on his mission to introduce colonies of Thrips for the biological control of *Clidemia hirta* (Kœster's Curse) in Fiji.

Mr. J. G. C. Campbell, B.Sc., was due to arrive in England on 1st September. He has been appointed as the representative of this Colony to attend the Imperial Mycological Conference to be held in London from 23rd September to 3rd October, 1929.

Mr. W. J. Blackie of New Zealand, has been appointed Government Chemist. He is expected to arrive in Suva shortly.

Captain L. B. Greaves was appointed as an Inspector in connection with the Banana Campaign on 12th August, 1929. He is now at work in the Navua district.

Captain Norman W. Faddy was appointed as an Inspector in connection with the Banana Campaign on 16th September, 1929. He is now at work in the Tailevu district.

CORRESPONDENCE.

It is requested that all correspondence on official matters for the Agricultural Department be addressed to the Superintendent of Agriculture, and not to individual officers personally. This procedure will avoid delay and inconvenience.

NOTE ON DESMODIUM FROM SOLOMON ISLANDS.

By H. W. Simmonds, F.E.S., Government Entomologist.

Regarding the *Desmodium*, introduced from the Solomon Islands by the late Superintendent of Agriculture, Dr. Tothill, this has now been identified for us by Kew and proves to be *Desmodium triflorum* L., and thus proves to be identical with the common species so widely distributed throughout the Group.

LIST OF PLANT NAMES, NAIVAKASIGA, BUA.

By W. L. PARHAM, Rukuruku Bay, Bua.

Botanical Name.	Customary Name (Wright's list.)	Bua Name.	Remarks.
Parinarium laurinum	Makita (Seeman)	Makita (tree), Mal (fruit), Mala (foliage).	Mala (foliage), of value for thatch.
Lygodium scandeons	Wa Kalou (J.H.)	Vereverete (i.e., tangle)	Medicinal value, also head covering. Inferior soil.
Andropogon sp.	Co Boi (Seeman)	Co bona (wild small type) Yaquyaqi (large cultivated) . ..	Typical of poor soil. Used as tea. Reputed obnoxious to mosquitoes.
Pleiosmilax vitiensis	Kadragi, Wa rusi, Na Kau wa, Sucumaihaka, Tokakaka.	Tudrumamikaka	Medicinal value. Vine of, used for mast rings.
Hoya sp.	Wabi (Guffy)	Drau bibi	Dry rocky hill forest.
Terminalia catappa	Tavola (Seeman)	Tivi (Tavola vaka-Bau) . ..	Local natives maintain these names as correct though aware of Vitilevu usage.
Terminalia littoralis	Tivi (Seeman)	Tivi ni Yalewa Kaloa	Typical of bad edephic condition; wet cold soil.
Cyperus pennatus	Davairaduna (Seeman)	Vesivesi	Inert silt soils.
Cyperus strigosus (?)	.....	Bakovekove	Kai Viti come to us often for this for ai lume. Name is rendering of a trade scent they buy, evidently Eau de Cologne.
Scleria sp. (?)	.....	Batavatava Aituiniduna . ..	Dry medium soil.
Cinnamomum sp. (introduced cultivated).	Cinnamon	Vuniokoloni Koloni	Imported plants corresponded in having as useless fruit as local ones. Common after fires.
Clematis pickeringii	.....	Wa mila Wa kaba	Foliage used for hair dye. Usable for ink.
Physalis peruviana	Cape Gooseberry (Seeman) ..	Boteboteyadre (name due to children's game).	Useless soil.
Pittosporum richii	(Nadiri) Totowiswi (A. Gray), Meade's list.	Totowiwi (tree), Manawi (foliage)	There seems another variety, Vico loa reputed inedible.
Lycopodium sp.	Leweninimi (Seeman and Wright)	Sauninini	Poor soil. Medicine.
Flagellaria indica	Turuka (Guffy), Duruka (Seeman)	Vico (also Turuka and Duruka) .	Cattle fodder.
Erigeron albidum	Conipapalagi Wavuwavu (Seeman).	Tubua	Drought resistant fodder. Medicine.
Ficus bambusaefolia	Loseloseniwai (Seeman)	Drokanigata (used for tea) ..	
Sida retusa	Qavinilawi W., Cavucidra W. ..	(Qavinilawi) Deni vuaka . ..	

ENTOMOLOGICAL NOTES.

By H. W. Simmonds, F.E.S., Government Entomologist.

Volucella obesa.

This handsome fly is one of the commonest and most conspicuous insects in Tahiti, Hawaii and the Cooks, but hitherto seems to have been absent from Fiji. On November 8th I took a single specimen in the office, whilst on January 3rd or 4th I observed a second at a lantana flower, also on the Reclamation. There seems little doubt that it is a new introduction and it appears to be establishing itself.

Most of the members of this genus are considered beneficial, acting as scavengers and two have been introduced into Australia to attack prickly pear (which they do subsequent to some previous injury).

The species under review has been intercepted in cucumbers imported into the United States of America but I have no information whether primary or following in some injury or over-ripe condition.—R.A.E., Vol. 10, p. 358).

WHITE SCOURS AND ALLIED CONDITIONS IN CALVES.

By H. M. Stuchbery, B.V.Sc., Government Veterinary Officer.

Bowel disorders which may be classified under the above heading appear to be increasing in Fiji. The outbreaks noticed recently may be classified under two heads—

(*a*) those attacking calves from 1–6 days of age;

(*b*) those attacking calves of a greater age, generally a fortnight to five weeks old.

The cause of these disorders is attributed to organisms of the Colon Bacillus group, chief among them being the *Bacillus coli* and *Bacillus paracoli*. It would appear from the age at which calves develop the disease that the latter organism is the causal agent of most outbreaks in Fiji.

At the onset of the disease, the affected animals refuse their food and stand in one place with a staring look. They become depressed and may lie down a great deal. Diarrhœa soon commences with greyish white fæces, often foamy and streaked with blood. The odour of this is very foul and penetrating. At first there is much straining, but later the fæces may be passed involuntarily. The body temperature is at first raised 1 to 3 degrees but later returns to normal or even subnormal. Restlessness is often observed. As the disease progresses the animals become very weak, the eyes sink into their sockets and become glazed in appearance. The coat becomes rough and the skin sticky from perspiration, while the anus remains continually open or even prolapsed. Finally the greatly emaciated animals become unconscious and die.

The treatment of this disease lies along two lines, curative and preventative. It cannot be said that curative treatment has, up to the present, been very successful and it is doubtful whether the number of recoveries obtained warrants the extra risk of spreading the disease by these affected animals. With proper isolation, however, this risk should be eliminated.

Curative treatment should be commenced with a purgative, from 1–2 tablespoonsful of Castor oil being especially useful. This should be followed by gruel such as barley water, linseed decoctions, &c. After the adminis-

tration of the castor oil, an intestinal disinfectant should be given daily. Suitable agents are:—Creolin, half teaspoon; Lysol, half teaspoon; or Salicylic Acid, 15 grains. These should be administered with the milk. Enemas of Lysol one per cent. also assist in the disinfection of the bowel tract. Persistent diarrhœa can be checked by the administration of flour gruel, one cupful, sulphate of iron 10 grains. These doses are suitable for calves about one month old, and may be varied according to the age of the animal.

The general comfort of the animal should be attended to. A warm dry place should be provided. Foul discharges should not be allowed to accumulate on the coat. Raw eggs are a great help in preserving the strength of the animal, and black coffee a good stimulant to overcome the general depression which always accompanies this disease.

As the infective agent is contained in the excreta of the animal, the immediate isolation of affected animals is necessary, while all fæces should be destroyed. Calves running in a paddock should be transferred to fresh land, or if they are kept in buildings the latter should be disinfected. A good disinfectant for concrete or other solid floors and walls in one per cent. solution of phenyle. For wooden buildings a lime wash of 1 lb unslaked lime, 1 cup phenyle and 1 gallon of water is suitable. All feeding buckets, &c., should be thoroughly scalded after use.

It is often noticed that calves that have recovered from the disease become unthrifty after weaning. This is due in the majority of cases to infestation by parasites which always attack weakly and debilitated animals more readily than strong ones. For such cases, the following medicines may be used:—

(1) Turpentine, 1 dessert spoonful; Linseed or Castor Oil, ½ to 1 cup.
(2) Copper Sulphate, 4–6 oz. of 1 per cent. solution.
(3) Tartar Emetic, 1 oz; Sulphate of Iron, 1 oz.; ½ teaspoonful of the mixture once a day for one week.

CARBON TETRACHLORIDE IN THE TREATMENT OF WORMS IN A HORSE.

By Chas. R. Turbet, B.V.Sc., Senior Government Veterinary Officer.

This experiment was carried out through the courtesy of Mr. C. Gordon Fenton, of Lami, to whom the mare belonged and to whom I am indebted for keeping the daily observations. It was conducted to test the efficacy of carbon tetrachloride in the removal of worms from horses.

Before treatment, eggs of strongylus worms were very numerous in the fæces of the animal in question. After a few days preparation of bran mashes the mare was stabled at mid-day and no food allowed for 22 hours. At 10 o'clock the following morning she was given 40 c.cs. of carbon tetrachloride, 6 oz. Epsom salts and 1½ pints warm water. The bottle was constantly shaken to keep the tetrachloride more or less in suspension. The horse did not object to taking the mixture, but was evidently disgusted with the taste afterwards. She was given light feed about 3 p.m. with water. No motion was observed until about 6 p.m., and as the horse was still stabled, it was evidently the first one since taking the dose. The dung was examined carefully, but nothing found. Another feed was given at 8 p.m. The next morning a fresh motion was found about 7 a.m., and on examination two or three *strongylus armatus* worms were found alive.

Every motion of the horse was observed for four days, and the number of worms passed was at least 500, including *strongylus armatus* and *S. vulgaris*. One motion on the third day was just one mass of worms, probably 80 to 100. No worms were seen on the fifth or succeeding days.

One distinctly noticeable feature was the almost immediate reduction of the abdomen, from being fully blown out or extended, as when late in foal, to less than normal proportions in four days. She looked rather sickly for about ten days and went off her feed, but by the end of two weeks she was on full rations and making splendid improvement in her condition. Her coat became glossy and she moved along with the spring and carriage which denotes good health.

No worm eggs could be found in the fæces after treatment.

Conclusion.—Carbon tetrachloride in a dose of 40 c.c. administered in 6 ounces of magnesium sulphate in 1½ pints of water was effective in removing all the strongylus worms from the alimentary canal of a mare with obvious benefit to the general health of the animal.

THE PRINCIPLES OF BIOLOGICAL CONTROL.

By J. G. Myers, Sc.D., F.E.S., Imperial Bureau of Entomology.

Probably ninety-nine out of every hundred people, when they think of the contributions of science to human welfare, recall the physical, chemical and mechanical inventions which produced the industrial revolution and are now engaged in the mechanisation of the world, and in the evolution of its new master, the centaur of the new civilisation—that half-man, half-automobile, envisaged by that brilliant recent writer, Woodruff, in *Platos American Republic*. We are not accustomed to think of *biological* inventions; by which we mean, with Haldane, "the establishment of a new relationship between man and other animals or plants, or between different human beings, provided that such relationship is one which comes primarily under the domain of biology, rather than physics, psychology, or ethics." The application of biology to the solution of human problems has as yet hardly begun. Haldane has shown that the number of great biological inventions can be counted on the fingers of one hand, and most of these were made before the dawn of history.

When mankind was at the hunting stage of culture, living only on animals and perhaps a few plants, secured with the aid of primitive tools, a Malthusian prophet might justly have envisaged, concurrently with improvement in weapons and in hunting technique, a gradual decrease and final extinction of the game, and with it the annihilation of the human race dependent thereon. It is improbable that he would have predicted the innovation—the first great biological invention, namely, the domestication of animals and plants—which was to save the future and ensure the continued evolution of man.

It is interesting to realise that until recent years there had not been, during the whole historic period, any noteworthy addition to the list of man's domestic animals. All had been the servants of man from the dawn of history, they had accompanied him out of the mists of antiquity and had materially assisted his emergence.

The principle of biological control involves a tremendous increase in the numbers of man's animal auxiliaries—it is, in fact, an extension of the first

great biological invention—the domestication of animals. It is true that the animals thus utilised are usually not domestic animals in the strict sense of the term, but there exists every gradation between these and such closely-domesticated organisms as dairy cows. Moreover, in what were in all probabiltiy among the first attempts at biological control—the destruction of rats and mice by dogs and cats—animals probably already domesticated were the agents. Ferrets, however, used against rats and rabbits, are very much less domesticated than dogs or cats and form a transition to natural enemies which are utilised without true domestication. It is these latter which are the chief agents in the biological control of insect pests.

The term " biological control " covers at the same time, a multitude of sins and a number of man's newest and most promising weapons in his struggle with the organic environment. We must carefully examine these, for with the increasing popularity of natural control methods it becomes more and more necessary to define clearly what reputable workers understand by " biological control," and to distinguish between what should be actually attempted in this sphere, and what must still remain the subject of cautious experimentation. The need is the more urgent from the fact that, as Thompson has recently emphasised, " economic entomology, though it finds in science its principles and its tools, is itself not so much a science as an art, like medicine. As in medicine, the practice of the art is always to some degree in advance of the written recipes and rules, which hardly do more than catalogue what experience has taught. One consequence of this is that while certain general methods gradually develop, there is a considerable period during which they can be learned only from the practitioners of the trade; another is that their general value remains uncertain until their scientific basis is critically examined. Such is at present the situation in regard to the biological control of insect pests . . . "

How then shall we define " biological control ? In a sense any method of combating a pest by means other than direct chemical or physical ones, is biological. The breeding of immune varieties of plants is one such, very promising, means. We would, however, limit the term to the utilisation of one kind of organism for the limitation or destruction of another. The theoretical possibilities of such a method are, of course, extremely numerous but we shall confine the following analysis to those cases in which attempts have been actually made or suggested. Even for these the accompanying table is not complete, but it will serve as a basis for discussion.

I. Control of injurious animals.

A.—By other animals.

1. Control of nematodes by predacious nematodes (Steiner and Heinly, suggestion only, 1922).
2. Control of molluscs by vertebrates (slugs and snails by birds, hedgehogs, &c.).
3. Control of insects and other arthropods by
   - (*a*) mites.
   - (*b*) other insects.
   - (*c*) birds.
   - (*d*) other vertebrates (*e.g.*, fish and newts against mosquito larvæ, toads against nocturnal insects, bats against mosquitoes).
4. Control of vertebrates by other vertebrates (*e.g.*, fish by fish, snakes and rats by mongoose, rabbits by weasels, mice and rats by birds of prey).

B.—By plants.

1. Control of insects and other arthropods by
   - (*a*) bacterial diseases.
   - (*b*) parasitic fungi.
   - (*c*) algae (*e.g.*, mosquito larvæ by *Chara* spp.).
   - (*d*) phanerogama, *e.g.*, scale-insects on lime trees diminished by allowing Bengal Beans to climb over trees. Montserrat, Ballou). *Melinis* grass against flies and ticks).
2. Control of injurious vertebrates by bacterial diseases, *e.g.*, rabbit in Australia, rats).

II. Control of injurious plants (Weeds) by

1. insects (*e.g.*, against prickly pear and *Lantana*).
2. mites (*e.g.*, against prickly-pear).
3. fungi (*e.g.*, against prickly-pear, blackberry, Californian thistle).
4. bacteria (*e.g.*, against prickly-pear).

In addition there are such border-line cases as that of d'Herelle's bacteriophage; and such indirect control as that of cattle flies by the utilisation of dung beetles, which render the manure unsuitable for their breeding.

Most of these cases represent actual attempts; a few are only suggestions. *As to their relative practicability, it cannot be too strongly emphasised that all are either in the experimental stage or may be dismissed as valueless, save the control of insects and other arthropods by insects.* It is far too frequently forgotten that this and this alone is the only sound general practice in biological control. To this must be credited every one of the sweeping successful applications of the principle. Only when this method has failed after years of trial, should the introduction of natural enemies other than insects (or other arthropods) be contemplated. The introduction and acclimatisation of predacious birds and mammals as a measure against pests (whether insect or vertebrate) has led to such disasters in the past, that it should be universally condemned. I need only mention the introduction of the mongoose into the West Indies, of the stoat and weasel into New Zealand, and of the English sparrow into North American and other parts of the world. So far as insect-eating birds are concerned, we should carefully distinguish, of course between the importation of foreign species and the encouragement of native ones which have been found useful to agriculture. As McAtee (1926) has recently shown, the local birds may be looked upon "as an ever-present force which automatically tends to check outbreaks large or small, among the organisms available to them as food. It is a force which should be kept at maximum efficiency by protective measures and which should be taken into consideration and used whenever possible."

Bird protection then, both passive, by restriction of killing, and active by establishment of sanctuaries and perches, and checking of ground vermin, may be looked upon as a general insurance against insect outbreaks. It can rarely be considered as a measure against individual pests.

Save that in their case, protection is less practicable, the same remarks apply to insectivorous mammals, lizards and amphibians, the two latter being especially important in the tropics.

The control of weeds by means of their insect enemies is still entirely in the experimental stage. The best known attempt—that directed against *Lantana camara* in the Hawaiian Islands, has been successful in that the plant has been largely prevented from seeding by insects introduced from

Mexico. By this means its re-infestation of cleared land and its furthe spread are greatly checked. The prickly-pear (*Opuntia* spp.) in Australia—the most spectacular weed in the world—is also, according to latest reports, gradually succumbing to the attacks of insects and mites imported, on a very large scale, from America.

Numerous observers, in many parts of the world, have been greatly impressed with the tremendous mortality among certain insect pests, under certain conditions, through the attack of fungous parasites and bacterial diseases. And just as numerous attempts have been made to reproduce these conditions artificially, and to control outbreaks by propagating the disease. In particular instances, sweeping successes have been claimed, notably by Le Moult and by d'Herelle, but later observers have usually failed to obtain similar results. One of the most thorough and careful workers in this field, Paillot (1916) came to the conclusion that " la création d'épidémies artificielles comparables, en intensite et en étendue, aux épidémies naturelles, soit a peu prés impossible dans l'etat actuel de nos connaissances; trop de ces facteurs interviennent, en effet, dans la propagation de ces épidémies, qui échappent plus on moins completement a l'influence de l'homme." Petch (1921) a mycologist who is perhaps the foremost authority on entomogenous fungi expressed the same conclusion even more strongly when he said:—

> "At the present day, after thirty years' trial, there is no instance of the successful control of any insect by means of fungous parasites. If entomogenous fungi already exist in a given area, practically no artificial method of increasing their efficacy is possible. If they are not present, good may result from their introduction if local conditions are favourable to their growth; but, on the other hand, their absence would appear to indicate unfavourable conditions."

So far as insect pests are concerned—and these are the worst of our troubles, we are thus left with control by means of their insect enemies. But even here, further analysis is necessary before we arrive at what is practicable and promising and what is not. With insectivorous vertebrates we have just seen that importations have usually proved more or less disastrous mistakes while encouragement of local species is recommended as a measure of general insurance. Precisely the opposite has been the case with insect enemies of insects, for here, as noticed above, all the most sweeping successes have been won with introduced parasites, while the attempted encouragement of native ones has usually proved futile. A consideration of these successes, and notably of those achieved in Hawaii, show that the most favourable circumstances may be summed up under four heads:—

(1) the pests to be controlled are immigrants, accidentally introduced without their natural enemies;
(2) the indigenous fauna is of a limited and peculiar kind, so that the chances of the immigrants finding new enemies in it are very small;
(3) the climate is warm and equable, allowing introduced parasites to multiply without seasonal checks;
(4) there are only a few main crops, so that high organisation and centralisation are possible, and a small improvement is rendered important by the large scale of operations.

Probably no other part of the world is quite so favourably situated as Hawaii in reference to all four of these conditions. But it is safe to say that any country possessing these four qualities in some degree, is favourably situated for biological control. One would expect that once suitable natural

enemies were discovered, imported and established, the task would in most such cases be accomplished, Probably the most unfavourable regions in which to attempt control of this nature lie in continental areas, with a rich and varied fauna, and a "temperate" climate, with a cold winter. In such areas it might be necessary to breed the parasites continuously in the laboratory and distribute them periodically, so as to force them into a condition of permanent dominance, to use the term of H. S. Smith. Such is the method used with the Australian ladybird, *Cryptolaemus montrouzieri*, in California, against the citrus mealy-bug. It is, of course, considerably more expensive than mere introduction and establishment accomplished once and for all, but at least in the citrus industry, it remains less costly than chemical measures of control.

This principle of assisting, as it were, the work of parasites already established, may theoretically be extended to indigenous natural enemies of pests either native or imported. In fact, the large scale utilisation of parasites already present, notably those of the codlin moth in California and of the sugar-cane borer (*Diatraea*) in Louisiana, is one of the latest developments of applied entomology. But such extension, whether on a large or on a small scale, has nowhere yet met with any striking success, and biological control as a whole should not be judged by the trial of it alone. The corollary is that the best results in biological control are to be expected in the future, as they have been obtained in the past, from the introduction and establishment of parasites from other regions.

When we come to the tropics it is often a matter of the greatest difficulty to decide whether a given pest is an introduced or an indigenous insect, and provided the entomologist ascertains exactly what parasites are attacking it in the various regions of its range, this becomes largely an academic question. The sugar-cane froghopper in Trinidad, evidently an indigenous insect, has very thoroughly adapted itself to cane-field, *i.e.*, essentially exotic conditions, while its local enemies have very largely failed to do so. The position thus simulates that of an insect introduced into a new country, without its natural enemies, and the way is open for the importation and establishment of foreign parasites which are as well adapted to cane-field conditions as the froghopper itself. The same principle applies to a number of other tropical pests.

A most essential part of the work consists in freeing the imported parasite from its own natural enemies (hyperparasites) before it is liberated. Mistakes of this kind are usually irrevocable.

The controversy as to the necessity for a sequence of parasites to attack various stages of the pests insect, with the dangerous tendency to the opposite extreme of super and co-parasitism, or the injurious competition of several parasites for the same individual hosts, seems now to have been resolved in the policy of sending one or two judiciously selected species at the beginning and observing their effect, before introducing others. The choice of species to introduce must, in the present state of our knowledge, be left in each case to the judgment of the specialised investigator who can study the pest and its enemies in the different parts of its range.

The emphasis on foreign parasites implies, of course that the task is not one for the local entomologist to perform single-handed. Biological control offers an extremely promising field for co-operative research, and with the foundation by the Empire Marketing Board of a special laboratory for this work under the Imperial Bureau of Entomology, its rapid further develop-

ment along these lines, throughout the Empire, seems assured. The mission of the present writer to the extremely promising field of the West Indies is the latest extension of the same organisation.

NOTES BY H. W. SIMMONDS, F.E.S., GOVERNMENT ENTOMOLOGIST.

The biological control of pests and weeds is of particular importance to Fiji, with its limited population, abundant rainfall and fertile lands, so that the article by Dr. Myers dealing with the scope and limitations of this subject should prove of special interest.

Dr. Myers strongly condemns the introduction of birds into a new country and quotes certain disastrous experiments in support. It should, however, be pointed out that the English sparrow and most of the introductions into New Zealand were omnivorous birds, which in their new home would naturally first select that which they preferred to eat and later, as that became scarce, turn to other foods.

The acclimatisation of purely insectivorous birds has seldom been attempted and there should be no more risk with these than with a specialised insect. If a bird can be transported for weeks across the ocean without the attention of a highly skilled ornithologist it must be too adaptable and generalised in its feeding requirements to be safe to transport to a new country.

In New Zealand and many other countries formerly covered with forest with a highly specialised avifauna the clearing of the land for cultivation led to the retreat of the native birds with the receding forests. Their replacement is a matter of great difficulty, as most birds of the open are general feeders and no attempt seems to have been made to make use of those which are purely insectivorous, such as nightjars, swallows, podargus and others whose transport presents great difficulties, but whose introduction would have avoided the disasters attendant upon the ill-advised use of sparrows, blackbirds, &c. It does not appear that the introduction of the birds is responsible so much as the absence of careful prior investigation, and it is only by the most detailed investigation that similar disasters with insects have been avoided.

COCONUTS, PINEAPPLES AND BANANAS IN MALAYA.

THE following abstracts from the Annual Report on the Department of Agriculture, Straits Settlements and Federated Malay States, for 1928 are of interest to agriculturists in Fiji, dealing as they do with these important crops:—

COCONUTS.

Area.—It is estimated that the total area now planted with coconuts in Malaya is approximately 520,000 acres, representing an increase of about 3 per cent. since the year 1924. About three-quarters of the planted area is believed to be made up of small holdings.

Markets.—The Singapore market price for copra, which at the end of 1927 was $11·50 per picul (133⅓ lb), opened in January, 1928, at $11·90, around which price it stood until the end of the month. Thereafter the price was maintained between $11·50 and $11·35 until the end of May. It subsequently declined to $10·10 at the end of August and then varied between this figure and $10·60 closing at the end of the year at $10. The average price for the year was $10·90 as compared with $11·17, $11·80 and $11·95 in 1927, 1926 and 1925 respectively.

Exports.—The exports of copra from the Federated Malay States for the years 1925 to 1928 are shown in the following table:—

State.	Quantity in tons.				Value in dollars.			
	1925.	1926.	1927.	1928.	1925.	1926.	1927.	1928.
Perak ..	40,007	44,542	39,499	45,451	7,830,274	8,905,033	6,862,402	7,535,319
Selangor ..	15,426	16,963	14,120	20,148	2,909,119	3,212,553	2,615,641	3,435,968
Negri Sembilan ..	2,236	3,417	3,302	2,251	463,494	575,451	562,528	381,675
Pahang ..	315	907	615	654	57,412	158,733	102,255	106,746
Total F.M.S.	57,984	65,829	57,536	68,504	11,260,299	12,851,770	10,142,826	11,459,708

Of the total for 1928, 20,486 tons were exported direct to foreign countries and 48,018 tons to the Straits Settlements.

The net exports of copra and coconut oil from Malaya during the last three years were:—

	Copra.		Oil.		
Year.	Quantity. Tons.	Value. Dollars.	Quantity. Tons.	Approx. copra equivalent.	Value. Dollars.
1926	104,653	21,852,330	8,458	14,000	3,090,953
1927	86,649	16,562,493	10,242	17,000	3,448,057
1928	95,091	18,747,129	9,828	16,400	3,168,881

General.—Whereas the crops for 1927 were below average, those for 1928 were satisfactory in most districts. The improvement in crop is partly responsible for the increase in exports, although an increase in the producing area is also a contributing factor, more especially in Perak, Selangor and Johore.

Data have been compiled from 30 representative estates in Malaya, which show that the average production of copra per acre from estates under European management is 8·73 piculs (1,162 lb) and that 251 nuts are required to produce 1 pikul (133⅓ lb) of copra (4,217 nuts per ton of copra).

Statistics have also been collected with reference to dwarf coconuts. These show that under fair average condition and with good management eight-year-old dwarf palms have given an average production of 11·68 piculs (1,557 lb) of copra per acre. One estate has produced 19·29 piculs (2,572 lb) per acre over an area of 100 acres, but this is exceptional. Under favourable conditions dwarf coconuts, especially the yellow variety, have not proved as robust as tall palms, but where conditions are good the green dwarf is a sound proposition.

The data collected also show that there is a seasonal variation in output of copra per acre amounting to about 15 per cent. of the average crop.

Experimental Investigations.—The information obtained from the records of individual yields from 471 trees, growing under average estate conditions, during a period of eight years, may be summarised as follows:—

(1) the co-efficient of variability of an average population is as much as 34 per cent. of the mean production per palm;
(2) variability in cropping per palm per annum ranged from 5 to 115 nuts;
(3) of an average population, 19 per cent. of the palms are not profitable in that they yield under normal treatment less than 40 nuts a year;
(4) fifteen per cent. of the palms produce 24 per cent. of the total crop;
(5) poor yielders remained poor yielders, while good yielders were constant to that character.

Data have also been compiled which show that the copra content of nuts from different palms of the same variety varies from 79 to 131 per cent. of the mean copra production per nut. Further data regarding variation in the oil content of copra from different palms and seasonal variation in oil content of copra from the same palms, are in process of compilation.

The Coconut Experimental Station at Klang has been maintained in good condition and the general growth of the palms is satisfactory. The manurial, cultivation and catch crop experiments are also being maintained on this area.

Manurial experiments on mature coconuts have been commenced on an estate block of 18-year old palms of which the individual yields are known for the last eight years.

The flowering and fruiting characters of three races of dwarf palms were recorded for the fourth year in succession and will be published in the near future.

A scheme for instituting research work on the preparation of copra has been approved and the Empire Marketing Board has undertaken to contribute a half share of the provision made for this work. In the meantime preliminary chemical investigations connected with this scheme have been commenced. Several analyses of copra from different estates have been carried out, as a result of which it appears that the oil content of estate copra, calculated on a moisture free basis, varies from 64 to 67 per cent.

Diseases and Pests.—The situation with regard to the complicated problem of palm diseases in Malaya has been considerably clarified. A general account of the whole of the palm disease investigations was published in the *Malayan Agricultural Journal* Nos. 9 and 10 of Vol. XVI.

Effects of Lightning.—Supporting evidence has recently been obtained which clears up the position with regard to bud-rot due to lightning, and shows that lightning is a factor of importance in the causation of palm diseases, more especially on estates of tall coconuts. Small clumps are often struck with the result that two or three palms in the centre are killed and exhibit symptoms resembling those of bud-rot, while from 6 to 12 of the surrounding palms are slightly damaged, having their leaves broken or discoloured at the tips. These findings are of importance since, when considered in conjunction with other evidence, they strengthen the probability that no definite form of epidemic bud-rot exists in Malaya. They also help to simplify the general problem of palm diseases by removing from the field of investigation certain phenomena which tended to complicate it.

The Greater Coconut Spike Moth (*Tirathaba rufivena*).—Work on this pest has been continued and it has now been confirmed that the removal of the sheath just before it opens results in an increase in the percentage of nuts remaining on the spike. The value of this method of treatment depends on economic considerations, but, since only 30 per cent. of the original female flowers reach maturity, it is probable that even a small increase in this percentage would render such treatment profitable.

Records made in the course of this investigation show that the fall of immature nuts reaches its maximum in the fifth or sixth week after the sheath has burst and that there is a slight secondary nut-fall in the eleventh to fourteenth weeks. All the factors influencing nut-fall have not yet been determined.

Setora nitens.—An outbreak of this Limacodid was reported on an estate on the Bernam River and later in the year on several estates in Lower Perak district. At first only the leaves of young palms were attacked, but later older palms in bearing became infested. Control measures recommended were hand-picking caterpillars and pupæ, spraying young palms with lead arsenate solution, and encouraging the spread of a Tachinid parasite. This last measure is achieved by the use of special cages containing a number of pupæ of *Setora* and so constructed as to allow the adult flies emerging from parasitised pupæ to escape, while the moths emerging from healthy pupæ are retained for destruction.

Artona catoxantha.—An outbreak of this moth in Singapore Island was reported in October, but it disappeared again during wet weather in November. Two other outbreaks on the South Coast of Johore were controlled by the parasites of the pest.

FRUIT.

Pineapples.—The area under this crop and the export of canned pineapples have been well maintained during the year. In Johore, where most of the fruit is now grown, three new factories were in course of erection. These will bring the total in Johore up to nine factories, while there are five others operating in Singapore and one in Selangor.

The following have been the exports of canned pineapples from Malaya during the last three years:—

	1926.	1927.	1928.
Weight in tons ..	40,634	40,134	46,400
Value in dollars ..	7,669,784	8,296,656	8,421,230

The United Kingdom is the principal consumer of Malayan canned pineapples, taking about 80 per cent. of the exports and offering a good market for fruit of reasonable quality at a moderate price.

With the help of the Empire Marketing Board and the Malay States Information Agency, exhibits of Malayan (Singapore) canned pineapples were staged at the British Industries Fair in London, the Canadian National Exhibition in Toronto, and the Imperial Fruit Show in Manchester.

These exhibits attracted considerable attention. Recent communications have, however, emphasised that, if Malaya is to obtain the full benefit of the excellent facilities thus afforded for bringing this commodity to the notice of the consumer and to be enabled successfully to face competition on the British market, the different grades of the product must be carefully standardised.

This important aspect of the industry was discussed at an informal meeting of packers and exporters with Mr. E. M. H. Lloyd of the Empire Marketing Board held in Singapore on the 2nd May, 1928. At this meeting both sections of the industry were able to exchange views and to learn from Mr. Lloyd the methods successfully employed in other countries for standardising similar agricultural produce.

Further investigations are being undertaken by this department with a view to consolidating the position, which the Malayan product holds on the United Kingdom market and to extending the demand to other parts of the Empire.

Bananas.—Considerable areas of this crop are established in Negri Sembilan as a sole crop, and in Selangor, Perak, the Settlement of Penang and Kedah as a catch crop usually with young rubber. All the produce is sold inside Malaya.

The study of banana diseases and of the relative immunity to these of the numerous local varieties of banana has been continued in an endeavour to obtain varieties immune to Panama disease. As mentioned in previous reports this study is of considerable importance from an Imperial point of view and is being undertaken in co-operation with the Royal Botanic Gardens, Kew, and the Imperial College of Tropical Agriculture, Trinidad.

A full review of the year's work is contained in the annual report of the Mycologist. It will suffice to state here that the two local varieties, which give good promise of conforming to the requirements of the European market namely, *Pisang embun* and *Pisang restali*, have been proved to be susceptible to Panama disease; and that this disease has been found in three small areas of land in different parts of the Peninsula.

A local bacterial wilt disease of bananas, similar to that occuring in Trinidad, is also being fully investigated.

A USEFUL FORMULA.

(From *Market Gardening in Queensland*, 1920.)

LIKE the lime-sulphur wash, this material has valuable insecticidal and fungicidal properties, and is especially valuable for treating all kinds of mites and red spiders, as well as the various mildews attacking roses, melons, cucumbers and many cultivated flowering plants. It is a very valuable spraying material, and one that should be much more used than it is, and I therefore give its method of preparation, which is as follows:—

Boil 3 lb of 98 per cent. caustic soda and 6 lb of sulphur in two gallons of water till dissolved; the result is a strong solution of sulphide of soda which can be used either diluted with plain water or with soap and water—$\frac{1}{4}$ to $\frac{1}{2}$ lb of soap to the gallon of water.

The concentrated solution should be reduced to one-sixtieth with water or soap and water, the two gallons thus producing 120 gallons of spraying material. Used at this strength it is very effective on all red spiders, mites and also young scales when newly hatched, and can also be applied to ripening fruits to prevent rot caused by fungus growths or to prevent mildew on roses, pumpkins, marrows, cucumbers, &c. (1 oz. soda, 2 oz. sulphur to 1 pint of water, prepared as above. Dilute to 7$\frac{1}{2}$ gallons for use).

If desired caustic potash can be used in the place of caustic soda, the result being the production of sulphide of potash or, as it is commonly called, liver of sulphur.

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